This Blessed Plot: When should Capital Gains on Land be regarded as Income

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Abstract

National balance sheets for a number of advanced economies show land to be a valuable form of natural capital, whose value has increased sharply over the last twenty years or so. This paper investigates when or whether capital gains on land should be counted as a component of income. While development projects can lead to increases in rental rates and land values, it is shown that, while the benefits any project should be counted as income, increases in rental rates and land values should not normally be seen as additional real income. However if land benefits from exogenous land-saving technical progress the resulting capital gains can be seen as income. Applying the same principle to human capital it is shown, on a steady growth path, that these capital gains are equal to Weitzman's (1997) growth premium in the relationship between income and sustainable consumption.

Keywords

Land, real income, capital gains, technical progress

JEL Codes

E21, E22, O4, Q24

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I. Introduction

According to the OECD, land is one of three forms of natural capital. OECD (2005) states "Natural capital is generally considered to comprise three principal categories: natural resource stocks, land and ecosystems. All are considered essential to the long-term sustainability of development for their provision of "functions" to the economy, as well as to mankind outside the economy and other living beings." All of these components of natural capital are essential to life in a way that produced capital is not. But a general principle of economics is that goods and services are valued with reference to their marginal benefit, and on that principle very low values are put on some natural resources. The output of the water industry is not measured with reference to the consumer surplus that people derive from access to clean water.

Applying the principle of valuation on the basis of marginal benefit, land appears much more important than other forms of natural capital. The UK national balance sheet does not yet show non-produced physical assets apart from land. However data for Canada and Australia, both resource-rich countries, are available. Land in Canada is valued at twice GDP while its stock of exhaustible natural resources is valued at 0.24 times GDP. For Australia, also a country rich in natural resources the corresponding figures are three times GDP for land and about 0.4 times GDP for exhaustible natural resources. Moreover in these countries, as elsewhere, land prices have increased very sharply over the last twenty years or so. Thus, in the UK the value of land increased from 1.2 times GDP in 1995 to 2.6 times in 2016. This paper is concerned with the question of whether those gains should be treated, as they are at present in the national accounts, as distinct from income, or whether they should be seen as a part of income as a number of prominent economists (Hicks, 1939, Eisner, 1988) have argued. The answer to this question is very pertinent to estimates of income over the period, given the magnitude of the increases.

The increase in land prices shown in the national accounts is, of course, observed by the public at large as an increase in house prices. The value of housing in the national balance sheet comprises the value of the land plus the replacement cost of the building. The latter is largely determined by construction costs and these have not moved very differently from broad measures of cost in the economy. So, what the public see as an increase in house prices is shown in the national accounts as an increase in land prices.

The housing or land market has been explored at both a micro and a macroeconomic level. Glaeser, Gyorouko and Saks (2005a) explained the phenomenon in terms of planning controls while a companion paper (Glaeser, Gyorouko and Saks, 2005b) investigated the local phenomenon of high house prices in Manhattan. Quigley and Raphael (2005) did the same for California. Combes and Gobillon (2014) looked at the importance of agglomeration and its effects on house prices. Knoll, Schularick and Steger (2017) show that rising house prices are a phenomenon of the last fifty years; until then house prices had been fairly stable. A wide range of studies has looked at the effects of local influence on house prices, with school quality being a topic of major interest and public provision of local amenities also considered. But these studies do not answer the question of whether gains on land or housing should be seen as income.

Macroeconomists have, until recently, largely ignored land and housing. They have focused almost exclusively on a structure in which there are two factors of production, labour and capital[1]. Labour input is assumed to be largely exogenously determined, notwithstanding that factors such as tax rates and benefit structures can influence labour supply. Capital is generally assumed to be solely a

[1] Although land was very important for classical economists

produced good, and the core growth model (Solow, 1957) sets out how the supply of capital can respond to changes in effective labour input.

As growth theory developed from the basic Solow model, however, two texts (Meade, 1968 and Nichols, 1970) addressed the issue of land. Meade made the point that if there are two non-produced factors of production, labour and land, steady growth in labour productivity at the rate of labour saving technical progress will be possible only if land is not required for production (i.e. if the elasticity of substitution is greater than one). With an elasticity equal to one, steady growth will be possible but the equilibrium rate will be lower than that of labour-saving technical progress. If the elasticity of substitution in production is lower than one, then the economy will eventually be constrained by the availability of land, and growth in output per unit of labour will grind to a halt.

Nichols sets out a fuller account of a balanced growth path. He makes the assumption that the rate of land-saving technical progress is the same as the rate of labour-saving technical progress; there is assumed to be a single produced good, which can either be consumed or used as capital. While his model takes both types of technical progress as exogenous, underlying his model is the assumption that progress is induced, and that societies have an incentive to innovate in a way which results in rates equal technical progress for both non-produced factors of production. A much more recent paper by Morris, Davis, Fisher and Whited (2014) provides a macroeconomic analysis of agglomeration effects suggesting that these would raise productivity. They show that this can deliver a balanced growth path, providing some sort of micro-foundation for the effects described by Nichols.

This paper begins by setting out the data on the value of land in the United Kingdom. It then proceeds to a discussion of the concept of income. This is followed by exploration of factors that can lead to changes in rents, and thus capital gains on land from both micro and macro perspectives. The conclusion is that, while it is sensible to treat increases in land values associated with technical progress as income, it is also possible to imagine circumstances in which rises in land prices are associated with worsening economic conditions, or at least greater demand for land. As a result it is not possible to produce any hard and fast rule of whether capital gains on land can be seen as income. But it is likely that large movements in land prices are likely to be associated with demand effects while only relative small movements will arise from technical progress. On these grounds a sensible prescription is to leave capital gains on land out of any comprehensive definition of income.

II. Land and Produced Capital in the United Kingdom

The physical capital of the United Kingdom comprises two broad categories of assets. On the one hand there are non-produced assets such as land while on the other hand there are produced assets such as houses, offices and national infrastructure. Finally, if we want to put these in the context of the overall wealth of the United Kingdom we also need to take account of financial assets. Looking at the nation as a whole, these largely net out: borrowing from banks is offset by deposits in bank accounts, for example. But financial claims on the rest of the world do not exactly match those of the rest of the world on the United Kingdom; the net financial assets of the United Kingdom also need to be shown in an assessment of the nation's wealth.

The national balance sheet provides data on the magnitude of these various components of national wealth. The only non-produced capital that it identifies apart from land is a negligible category of permits to undertake specific activities. It does not include any specific estimates of marketable natural resources such as minerals, although the value of land may itself be affected by the value of resources associated with it. In the balance sheet produced capital is values at its replacement cost. Land, because it is not produced, is valued at its market price.

These data, available for the first time in the 2017 *Blue Book* allow us to compare the role of land with that of other capital assets. Figure 1 shows the money value of produced and non-produced wealth at the end of each year since 1995. It is clear from this that land has become relatively more important over time. There was a small positive component to financial net worth at the start of the period and a more pronounced negative component in the first half of the current decade. But the diagram suggests that was not large relative to the UK's produced and non-produced wealth.

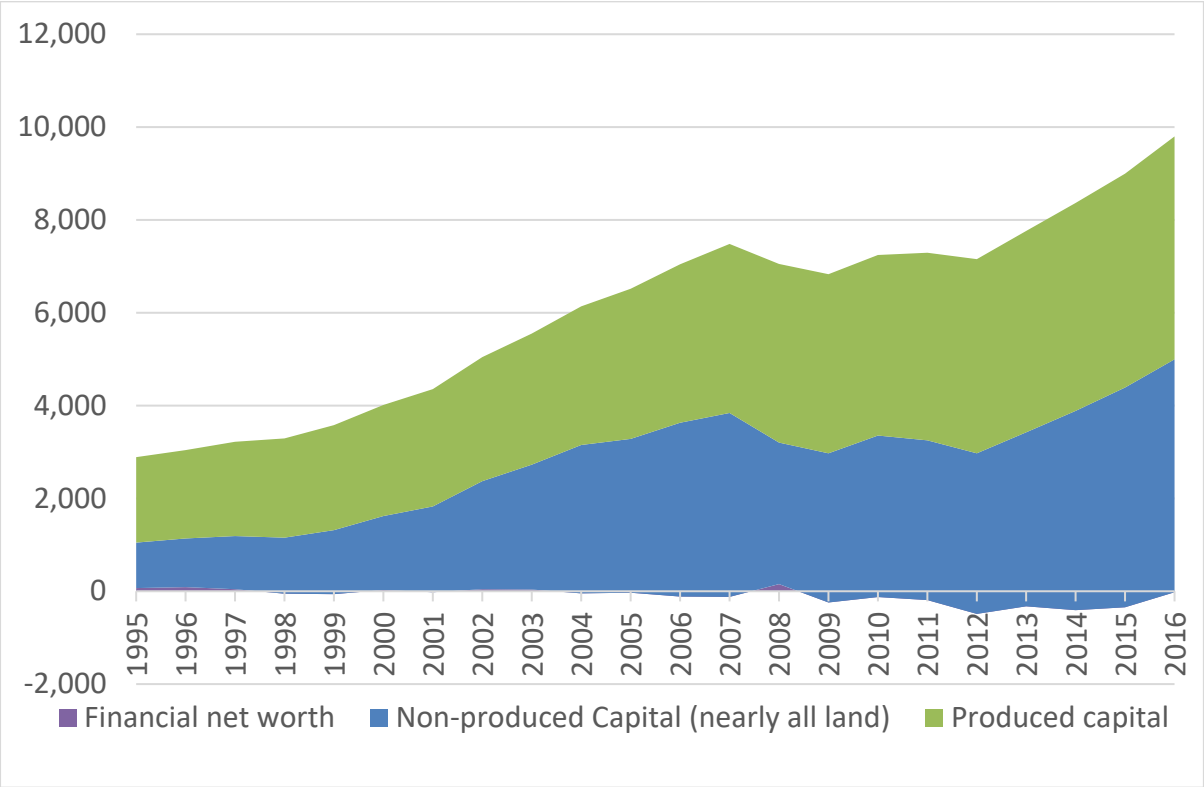

Figure 1: Components of UK National Wealth (£bn)

An alternative way of presenting the data is to show them as a proportion of GDP during the year. This makes it possible to judge the importance of wealth relative to the size of "the economy".

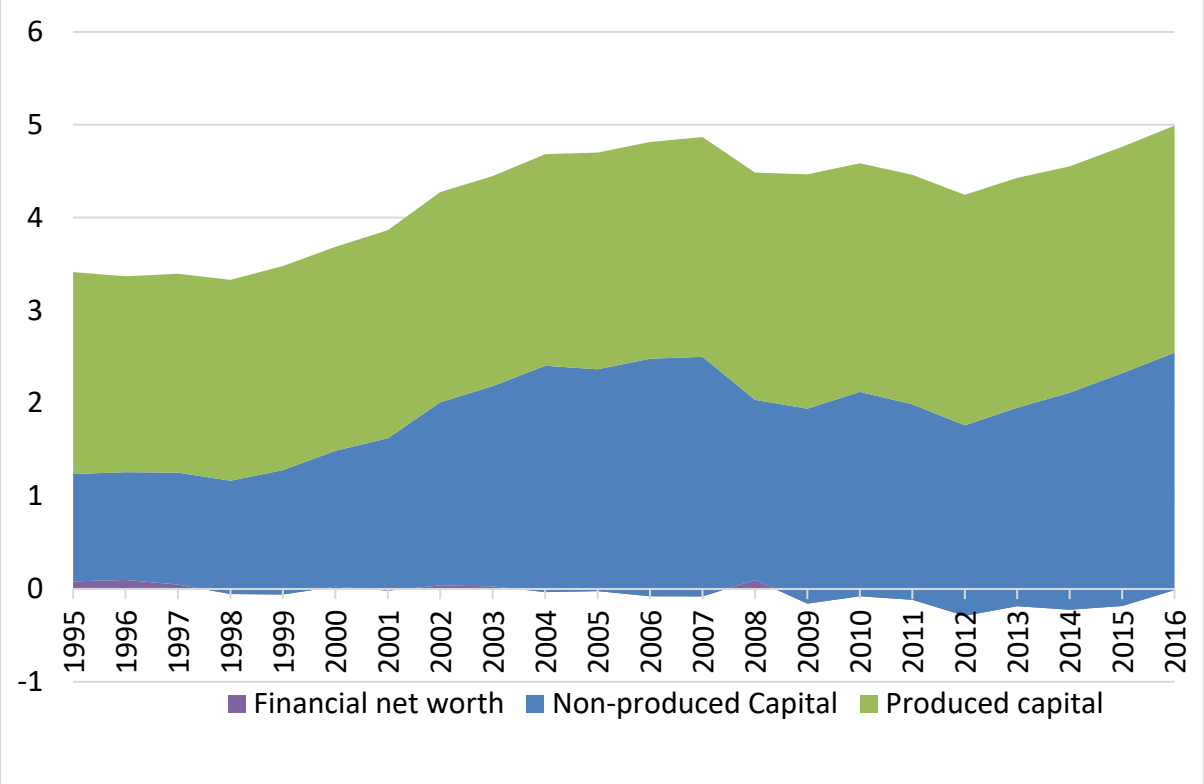

Figure 2: UK National Wealth as a Multiple of GDP

We can see that UK wealth increased from 3.4 times GDP in 1995 to five times GDP by the end of 2016. The amount of produced capital, relative to GDP increased slightly from 2.17 to 2.44 times, but the value of land increased sharply from 1.15 times in 1995 to 2.56 in 2006. The value relative to GDP fell after the financial crisis, but at the end of 2016 it had returned to 2.56 times GDP. The value of land grew at an average of 8.1 per cent per annum between 1995 and 2016 while nominal GDP grew by 4.1 per cent over the same period. But, as chart 2 suggests, this is very much a tale of two halves. Between 1995 and 2007 the value of land rose by 12.4 per cent per annum, while from 2007 to 2016 the rate of growth was 2.7 per cent per annum. The comparable growth rates of nominal GDP were 5.1 per cent from 1995 to 2007 and 2.8 per cent from 2007 to 2016. According the balance sheet land now comprises more the half of the nation's wealth[2].

Inevitably the distinction between land and produced capital is not clear-cut. Improvements to land such as drainage are logically distinguished from land and should be included with produced capital, but in many parts of the United Kingdom there is little land in its natural state. In built-up areas it is possible to value built-up land by deducting the cost of replacing the structures on the land in question from the market value of the buildings (including the land). But this value includes the benefits of access to infrastructure and agglomeration benefits. Thus, with this approach, if structures are priced at their replacement cost, the value of all the external benefits associated with location are rolled up into the price of land, and in that sense the value put on land is a residual.

But even then market prices tell us only a part of the story. The private sector may not be in a position to charge for all the benefits resulting from the land in its current use. Thus Farr (1839) argued for a park in the East End of London, on the following grounds:

[2] It is worth also reflecting on the importance of land relative to intangible capital as discussed by Haskel and Westlake (2018). If gross investment in intangibles is 10% of GDP as they suggest, and the depreciation rate is 25% per annum, the stock of intangible assets will be about 40% of GDP.

"A park in the East End would diminish the annual deaths by several thousands, and add several years to the lives of the entire population."

Such benefits would be entirely absent from any calculation which valued Victoria Park, as it was called, on the basis that it could, at the margin, be used for slum housing- then the predominant private sector use of land in the area. This simple example serves to demonstrate the difficulties in producing aggregate land values, and the reasons why further work needs to be done on the valuation of natural capital.

III. The Concept of Income

Should increases in land values like those shown in figures 1 and 2 be seen as income. Hicks (1938) defined income as :

"the maximum amount of money which an individual can spend this week, and still expect to be able to spend the same amount in real terms in each ensuing week"

This is widely interpreted to mean that, after adjusting for inflation, capital gains should be included with income. Such an approach, in turn, has its roots in Schanz (1896), Haig (1921) and Simons (1938). They defined income as consumption plus increases in the value of savings. Thus, while they included capital gains, they did not pay any attention to the effects of inflation; in contrast Hicks' definition does.

Eisner (1988) in his total incomes system of accounting, adopted the same approach. He argued

"It is real capital gains or what may be called 'net revaluations', that is, changes in capital values net of those changes necessary to keep real value intact, that would be included in saving, capital accumulation, and income".

This points a strong body of opinion that, at least after adjusting for inflation, capital gains on assets should be included as income, with the obvious implications that, at least on a balanced path, gains on land should be included.

For incremental changes it is quite straightforward to put some flesh round Hicks' definition. Suppose that there is a single good which can be used either for consumption or capital investment. If an amount of this good, ΔY simply appears (manna from heaven), then the Hicksian definition implies that it should be counted as income. It is worth noting that it can either be consumed in the period in which it appears, or invested to generate a subsequent flow of income. On this basis we would treat a windfall as income even if it is invested and generates a further stream of income. But it should be noted that, although the income generated can be "double-counted" in this way, consumption cannot be. The income generated, discounted at the rate of return, has a current value which is exactly the same as the increase in consumption possible if all of the windfall is consumed in the period in which it is received. The key point is that a windfall is treated in exactly the same way as a component of factor income. If consumption and capital goods markets are distinct, the windfall does not have to be in terms of consumption goods. At the margin, if markets are efficient, a windfall of capital can be changed into consumption or *vice versa*.

This approach can be applied to assess the income generated by carrying out a microeconomic project which leads to better use of resources and is comparable to a windfall. In the period in which the project is carried out, the income generated is equal to the capitalised value of all future net benefits. And in subsequent periods there is an additional income equal to the net flow of benefits.

Once again, it would be possible to enjoy all of the income at once by borrowing an amount equal to the capitalised value of future benefits and consuming it. In that case there would be no net income in subsequent years, because the capitalised value of the benefits would have been consumed in the period when the income arose. We now explore how far this argument holds when applied to changes in land prices.

Land Prices and Income in a Partial Equilibrium

The first framework we use to explore changes in land prices draws heavily on the analysis provided by Starrett (1997). His starting position is that changes in land values should not be taken into account in assessing the benefits of any local development project, provided the benefits from the project itself are properly assessed.

The argument behind this is more easily set out in terms of rent rather than capitalised values. Since the analysis is partial equilibrium we assume that any change has no effect on the rate at which rent is capitalised; we take the market interest rate as fixed. Given the partial nature of the analysis, we need look only at whether changes in rental income should be included in any assessment of the benefits of a particular project, and, if everything is marketed, the income it therefore gives rise to. If changes in rent do not reflect changes in welfare then there is no case for including the capital gains on land in any indicator of changes in welfare and thus they should be kept out of any assessment of the incremental income generated by a particular project.

Starrett's argument is as follows. Suppose that a project has two effects. It generates a direct profit, but it also leads to an increase in the rent on land. If profits accrue equally to a number of households but they have to pay rent for the land that they use, and the amount of land, also equally shared, is in fixed supply, then the income of each household increases by its share of the profit plus its increase in rent received. However, the rent paid by each household increases in line with the rent received, so that the net benefit to each household is simply its share in the profit earned. This suggests that changes in rent, and thus changes in land value, should be left out of the picture; the increase in rent is a price increase and not a real income increase.

Increased Demand for Land

Of course this raises the question, why did rent increase. One obvious reason is that the project takes up land so the overall availability of land in the rest of the economy falls. Suppose as before, all the income eventually accrues to households. Each household derives utility from its consumption, and its use of land.

Consumption depends on exogenous income plus the household's share of rental income less the rent that the household pays out. If all households are identical, then rental income nets out and consumption equals non-rent income.

Now consider the increase in welfare arising from the project calculated by adding together the marginal increase in welfare arising from extra consumption, and the change in welfare associated with the changed availability of land. Consumption increases but the availability of land declines. With the price of consumption normalised to one, the increase in welfare is proportional to the increase in consumption less the reduced availability of land multiplied by the rental rate.

The increased income of the household is given by its share of the profit generated by the project has to pay for the land that it uses, plus the increase in the rental cost of its share of the national plot. Once again we find that the extra income generated by rent matches the extra expenditure.

It follows that, assuming marginal allocation conditions are satisfied, the increase in welfare is calculated by differentiating the utility function with respect to consumption and land in turn. The increase in welfare is then the sum of each of these derivatives multiplied by the change in the amount of consumption or land respectively.

The benefit of the project is measured by the consumption that it generates less the rental cost of the land used up in the project. But the fact that it has led to higher rent and thus to higher land values does not enter into the calculations, because this higher rent received is matched by a higher rent charged. As before, that income could be capitalised, but it is important not to confuse that capitalised value with the increase in the price of land associated with the increase in rent which arises from greater scarcity.

Externalities

An alternative reason for an increase in rent might be that the project increases the amenity offered by land affected. Amenity benefits are available to the public but are not traded in any market. They are logically distinct from land because they arise from one particular use of land which generally has multiple uses. Victoria Park is a good example.

A plot of land close to a park offers both somewhere to live and the amenity of proximity to the park. Instead of the project creating an income at the cost of a loss of land, suppose now that it creates amenity at the cost of a loss of land. We have already seen that changes in rent net out. A calculation similar to that above yields once again that the increase in welfare is the increase in amenity, measured in welfare terms, less the welfare loss resulting from reduced access to land. The increase in rental value may reflect the amenity to a greater or lesser extent, but, provided the amenity is valued, the increase in rental value should not be seen as a further component of the income arising from the project.

But this brings as back to the question raised in the discussion of Victoria Park. How should one treat assets like parks which are not marketed? This cannot be addressed without asking what is the optimal allocation of land between provision of amenity, like Victoria Park, and private use. The aim should be to expand the park to the point where the marginal increment to amenity is valued equally with the rent on the marginal land required for its expansion and thus the benefit to the average household from extra park exactly matches the loss from having less land in private use. Of course this requires valuing the amenity, as described by Farr, at the margin rather than in aggregate. The question of how much deaths would be reduced by an extra square metre of park seems rather difficult to answer even before one comes to the question of how to value the lives saved.

If one is, nevertheless prepared to make the assumption that land is optimally allocated between its different uses, then, despite the apparent difficulty raised by amenities such as parks, a straightforward basis for valuation appears. In terms of accounting for land use in the national balance sheet, the implication of this is that parkland should be valued on the basis of alternative private use. Such a calculation is likely to face the criticism that it pays no attention to the consumer surplus arising from the provision of parkland, and this is of course true.

Returning to a situation where public land is like private land, and comparing a situation where a positive amount is used as parks compared with one in which no land is thus used, rents will be higher in the second case because the private sector will have access to less land. Allocation of land as parks will result in capital gains on the land which remains in the private sector. If parks are

valued on the basis of private sector use, then the creation of parks will lead to increased land values for the whole of the stock of land.

A moment's thought shows that the mere fact that land values increase is not itself indicative of an increase in welfare. Suppose that land is already optimally allocated between parks and the private sector, but then the area of parkland is increased at the expense of the private sector. Land prices for private sector land will increase further, and these increases will be applied across the whole of the land area. But, *ex hypothesis,* welfare has declined as the area of parkland is increased beyond its optimum.

Starrett suggests other examples where changes which result in increased land values are associated with reductions rather than increases in individual welfare. Suppose for example, that an increase in population results in an increase in congestion in cities. If employment is concentrated in the central areas of the city, then increased congestion will lead to increased travel times from the outer suburbs. Will rents rise in the inner suburbs or fall in the outer suburbs? Starrett suggests that we can answer this question by considering a situation where central city jobs are high paid while those on the margin of the city are low paid. At some distance from the centre of the city, the higher pay offered by central jobs will just be offset by the travel costs so people will be indifferent between taking low-paid local jobs and high paid central jobs. Here the rent on land, or at least that component arising from proximity to the city centre falls to zero.

There have, however, been a number of studies looking at environmental influences on house and thus land prices. They are underpinned by an analysis provided by Rosen (1974) who showed that, in a society with well-behaved utility and cost functions, and in which goods are available in continuous quantities, then the marginal effect of some influence on house prices, such as might be estimated using a hedonic regression, will reflect public willingness to pay

Perhaps the most widely studied application of this is the effect of schools on house prices. Families with school-age children may choose to pay a premium to live in an area which lies in the catchment area for a school that is highly regarded. Thus Rosenthal (2003) measured secondary school quality by the proportion of children gaining at least five GCSEs at grades A to C, finding that a 1 per cent increase in the log of the odds ratio of the performance measure increased house prices by 0.05 per cent. In order to address the point that school performance may be more generally reflective of the characteristics of the area, Ofsted. ratings are used as instruments. This does not resolve the issue completely because, of course, Ofsted scores may be influenced by exam results. But, taking the results at face value, the school premium can be used to represent the value that people put on school quality.

But Kuminhoff and Pope (2014) question whether hedonic regressions do in fact deliver what is expected of them, noting the risks of omitted variable bias. In the example they consider, that of school quality, they suggest that conventional estimation techniques under-estimate willingness to pay for school quality.

Coate and Ma (2017) explore further the issues associated with the provision of public goods, examining the idea that if an increase in provision raises local house prices it must represent a move towards optimal provision while if it is associated with a reduction in house prices it is indicative of over-provision. Of course, over-provision will lead to a fall in house-prices only if the costs of the over-provision are borne by the householders in question, a proposition not very relevant to the United Kingdom where the connection between local tax revenues and local government spending is weak. But they also show that a simple relationship between house prices and the provision of

public goods will arise only if the socially optimal level of provision maximises the surplus that residents can expect to receive in equilibrium and they suggest that plausible decision-making processes may not deliver this.

Trying to generalise from these observations structured round a partial equilibrium raises further issues. School premia probably reflect differences in quality in different locations rather than absolute levels. There is every reason to doubt that a general increase in school quality would lead to a general increase in property values. But a second concern arises when trying to generalise. The increase in rents and land values close to good schools represents an appropriation of the incremental labour income that children are expected to earn in the future as a result of attending good state schools. That might suggest that not only should any increase in land values be left out of any definition of income, but further that the rental premium itself is more appropriately considered to be transfer income than factor income.

These micro-economic examples have illustrated Starrett's (1997) point, that increases in rent associated with micro-economic projects should not be seen as additional benefits. They represent increases in costs as well as increases in income and, as such, should be expected to net out. Furthermore it is perfectly possible to imagine projects which result in increases in rent as overall welfare declines. Over-extension of amenity land provides a simple example of this. With this background we now turn to macroeconomic models in which capital gains on land can occur, and study how these gains feature in national income, the comparable macroeconomic aggregate.

IV. The Macroeconomics of Land and Produced Capital

The standard model of production used by economists is essentially that of the Solow growth model. There are two factors of production. The first, labour, is not produced while the second, capital is produced. If the effective amount of labour increases over time, because i) actual labour input grows, ii) labour becomes more productive as a result of increasing education attainment, or iii) labour productivity grows for purely exogenous reasons, then, if adequate resources are devoted to investment, the capital stock can grow in line so as to keep the amount of capital per effective unit of labour constant. As we noted in the introduction, Nichols (1970) extended the standard growth model to a situation where land is a second non-produced factor of production. He showed that, with the assumption that land-saving technical progress and labour-saving technical progress accrue at the same rate, it was possible to set out a balanced growth path. Land-saving technical progress is a slightly awkward concept, but there are a number of straight-forward examples. The development of high-yielding grain is one example; another is the invention of the express lift, making it possible to build taller buildings. Miles and Sefton (2017) show that the development of transport technologies which reduce travel costs provides an exact analogy to land-saving technical progress.

In Solow's original model the saving rate is assumed exogenous. A consequence of this is that, with high rates of saving it is possible for the rate of interest to fall below the rate of growth. This state of affairs, explored in further detail by Abel, Mankiw, Summers and Zeckhauser (1989) is dynamically inefficient, in that it is possible to increase consumption in both the short and the long run by saving less. In Nichols' model income is defined as including the capital gains on land as well as the earnings on factor income, it is easy to see that driving up the price of land increases the income stream out of which saving can take place. Provided an increase in the propensity to save pushes up the price of land more than in proportion, then a sort of widow's cruse[3] would mean that money income, as

[3] In fact the widow's cruse was time-limited (see I Kings XVIII:14). The process described by Nichols could run indefinitely.

defined by Nichols would increase as needed to ensure that the savings urge could be met. But does Nichols' definition of income make sense.

In the appendix it is suggested, following Weitzman (1976), that income can be defined as "sustainable" consumption- that level of consumption which could be held constant on the balanced growth path. If both the rate return on capital and the rate of growth of income are constant, then there is a simple relationship between the two. It is demonstrated that sustainable consumption is equal to income excluding any gains, plus the increase in the capitalised value of non-produced capital. One component of this is land- thus capital gains on land need to be included with income. But a second component is the gain on human capital, the capitalised value of the labour supply. Just as the capitalised value of land is given by discounting future rental income, so the capitalised value of labour income is evaluated by discounting the stream of future wages. With technical progress being both land and labour saving, it is not surprising that they should both be treated in the same way

Thus, on the balanced growth path, sustainable consumption is equal to current income plus capital gains on the non-produced factors. If "as well off" means being able to achieve a constant level of consumption, then, on the balanced growth path, the Hicksian notion of income needs to include capital gains on those assets which benefit from exogenous technical progress.

The conclusion which follows from this is that, when capital gains on land arise as a consequent of technical progress, it is sensible to regard those gains as a component of income, in exactly the way that Nichols does. But the analysis also suggests that, for the purposes of income accounting, we should, following Petty (1699) and Nicholson (1891), capitalise future labour income. We would then also count as income those gains accruing to discounted human capital as a result of technical progress.

Sefton and Weale (2006, proposition 3) show that the increment to life-time utility arising from saving is equal to the amount saved multiplied by the marginal utility of money. Here we simply state that it is possible to show that this definition of saving is entirely consistent with the idea that income should be defined to include capital gains. With this definition of income saving is indeed equal to the rate of change of life-time utility multiplied by the marginal utility of money.

A " Counter-example"

If this has demonstrated a situation in which it makes sense to include capital gains on land as income, it is, nevertheless, easy to produce a macroeconomic example where it would seem perverse to include capital gains as income. If we consider the problem faced by a consumer who decides how to allocate their consumption over time, we can establish what rate of return on capital is needed to deliver a consumption path consistent with the growth rate of the economy[4]. The precise link depends on the relationship between consumption and the welfare that people derived

[4] For balanced growth to be possible the utility function has to show a constant elasticity of inter-temporal substitution. We therefore write the utility function as

$$U(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$$

where $1/\sigma$ is the elasticity of substitution. With θ the discount rate, the Euler equation is then

$$\rho_k - g = \theta - g(1-\sigma)$$

If σ>1, then a fall in the growth rate would result in a fall in $\rho_k - g$ and thus an increase in the value of land or human capital valued by capitalising current rent or labour income

from that consumption. However, plausible assumptions suggest that the rate of return on capital will fall more than one for one with any fall in the growth rate. Rachel and Smith(2015) do indeed suggest that a reduction in growth potential is one factor behind the sharp fall in real interest rates we have seen over the last twenty years, although it should also be noted that Bean (2016) gives only limited importance to it. If the return on capital does indeed fall by more than the growth rate, then the value of land (and capitalised labour income) will rise. So the capital gain enjoyed by their owners will be indicative of worsening economic conditions. In contrast to the earlier examples, it tells us that the future will be worse rather than better than previously expected.

This effect, even if present, can probably account only for a part of the increase in land prices relative to GDP shown in figure 2. If the rate of return is initially six per cent and the rate of growth is two per cent, land is priced at twenty-five years purchase. If σ=2 in the expression shown in footnote 4, then a fall in the growth rate of one percentage point will result in an increase in the price of land by a third. Figure 2 showed something close to a doubling.

We do not offer here any explanation of what might lead to such a substantial increase in land prices. The case we have been able to make for the inclusion of gains on land in a broad measure of income applies only to those gains which accrue at the rate of growth of GDP per employee and not to the sort of gain we have seen relative to GDP. That perhaps suggests that choosing between two broad measures, one including all capital gains and the other excluding them, the second might be a better indicator of movements in sustainable consumption.

V. Reconciliation: when does an Increase in Land Prices count as Income

These different models have shown that in some circumstances increases in land prices should count as income while in other circumstances they should not. But what precisely are those circumstances. In the micro-economic analysis land entered into the utility function directly while in the macroeconomic model utility was derived from consumption. But, if we were to substitute for consumption in terms of the factors of production used to deliver that consumption, we would find the effective rather than the actual stocks of labour and land entering into the utility function. So, in the macroeconomic case the stock of land in the utility function is in effect growing while in the microeconomic case it is not. But in the macroeconomic case we observe not more land but more effective land. The amount in terms of hectares is unchanged but the price per hectare rises in line with the growth of the effective stock of land and in line with its effective rental value.

The answer to this comes from our very first example. If someone experiences a windfall it makes sense to count it as income. If they encountered a windfall of land that, like any other windfall, should be counted as income. The model of economic growth we set out is one in which people enjoy what amounts to a windfall of land in every period. But the windfall comes not as more physical land but as more productive land. That is measured by the capital gain on the existing stock of land.

In the partial equilibrium we examined, in contrast, the increase in the price of land occurred because of a reduction in the availability of land. Such increases should not be counted as income despite the arguments of Hicks (1939) and Eisner (1988).

This argument extends to natural capital. An increase in the value of natural capital because rising incomes mean that people put a higher value on that natural capital should not be treated as income. By analogy with the argument made about rent, the increased “rent” on the natural capital may accrue to the public but they also have to pay more to enjoy the natural capital. Similarly, if a

reduction in the rate of growth generates an increase in the capitalisation factor, then, as with land, that is a sign of a worsening future rather than a pointer to extra resources than can be consumed.

It is perhaps hard to think of an analogy to enhanced productivity of land for natural capital. Improved access can result in greater use of natural capital for recreational purposes, but it may also lead to a loss of amenity due to congestion. Nevertheless the same point applies as with land. Any change which has the effect of increasing the effective "volume" of natural capital, net of the costs associated with that change can indeed be seen as an increment to income in the year in which it happens.

VI. Conclusions

The United Kingdom's balance sheet suggests that land is slightly more important than produced capital as a component of the nation's wealth. There have, moreover, been very substantial increases in the value of the stock of land over the last twenty years or so. This, in turn gives rise to the question of whether a broad definition of income might reflect not only national income as it is conventionally measured, but also some contribution from these capital gains.

It is shown here that, if income is defined as sustainable consumption, an argument can be made for accounting for the capitalised value of any exogenous increment to income as income in the period in which it occurs. By exact analogy with any investment which takes place out of conventional income, it is reasonable to count as income both the capitalised value of the increment in the period in which it occurs, and the subsequent flow of incremental income.

This might suggest that an increase in land prices should be seen as a component of income only if it is exogenous to the economic process. While it has not been possible to prove this, a partial equilibrium exploration of the effects of projects which add to welfare but at the cost of reducing availability of land and thus increasing its price, suggest that the welfare arising from such projects needs to be measured net of the rental cost of the land used by the project, and that the resulting increase in land prices does not represent an increment to welfare and thus to sustainable consumption. It is possible that some projects may raise the value of land because of the external benefits that they offer, but even here it is shown that, provided those external benefits are properly accounted for, the associated change in land prices should not be regarded as income. Moreover, it is not generally true that changes in land prices provide a good measure of changes to external benefits. They may also, for example, be affected by increased scarcity of land. An increase in the amount of land used for amenity purposes will result in an increase in the value of surrounding land, because of its increased scarcity. But using land for amenity purposes will be desirable only up to some optimum level. Beyond that further allocation of land to amenity will worsen welfare, as the reduced availability of land for private purposes has effects which dominate the increased amenity. But with any given amenity use, increasing the amount of amenity will always reduce land availability and thus increase land prices. Thus the rise in land prices cannot, on its own, indicate increased consumption opportunities.

Looking at the issue in macroeconomic terms, where growth results from exogenous supply gains, sustainable consumption is higher than current income conventionally defined. We have shown that the difference between the two is measured by the capital gains on the assets which benefit from exogenous supply gains. It follows that, in this case it is perfectly reasonable to define income with reference to sustainable consumption and thus include those capital gains as a component of income. The associated definition of saving is also consistent with the theoretical relationship between saving, the marginal utility of current consumption and the rate of change of life-time utility.

That does not, however, imply that it is sensible to treat all capital gains as components of income. A macroeconomic example is provided whereby a reduction in the underlying rate of economic growth leads to capital gains on land. These gains are therefore an indication of lower rather than higher future consumption.

Overall, then, we have not found a case for including gains in the value of land relative to GDP in any broad measure of income. Where it is possible to be sure that increases come from land-saving technical progress or its equivalent, there are good grounds for counting capital gains on land as income, but it is unlikely that this is the dominant factor behind the large increase in land prices we have seen over the last twenty years. If a single principle is to be adopted it is that gains in land prices should not be seen as income.

More generally, it has to be recognised that the assumption of optimal allocation implies that valuations of land have to be based on market use, whether or not the land is used for market activities. Such an approach is reasonably coherent for core national accounts but it is likely to be incomplete as a description of natural capital. First, some of the choices may not easily be amenable to marginal calculations. Secondly, the amount of consumer surplus associated with amenity land may be greater than that associated with land used for individual market activities. Both of these observations point to a need to supplement national balance sheets with the sort of information on national capital (ONS 2018) which ONS has recently started providing.

VII. References

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Appendix: Nichols' Model of Balanced Growth with Land

Nichols follows Solow in making the assumption that the rate of saving is exogenous, but he defines income to include the capital gains which accrue to land as a result of exogenous technical progress. On a steady state growth path, with labour and land-saving technical progress proceeding at rate *g* he shows, not surprisingly, that the rental rate on land also grows at the growth rate *g*. Its price will be given by the present discounted value of its marginal product $\rho_{land,t}$. at time *t*. This also grows at a rate *g* and, with a single consumption/capital good the interest rate is ρ_k, the marginal product of capital, then the price of land in period *t* is given as

$$P_{land,t} = \rho_{land,t}/(\rho_k - g) \quad (8)$$

if $\rho_k > g$, but it becomes infinite if $\rho_k <= g$. This leads to the observation that economies with land do not become dynamically inefficient; instead the price of land tends to be bid up (see Rhee, 1991).

In order to see how the concept of income relates to capital gains, we start with the familiar requirement that investment equals saving. We denote saving as s while investment is the rate of growth of the capital stock *gk*. With both measured as a proportion of income, we can write

$$\frac{s}{y} = \frac{gk}{y} \quad (9)$$

We assume that the share of income accruing to the factors which enjoy exogenous technical progress (labour and land) is ω. Then we also know that the share of capital, the only factor of production which does not benefit from technical progress is $1 - \omega$. This has to equal the income accruing to capital, $\rho_k k$, measured as a share of factor income.

$$1 - \omega = \rho_k k/y \quad (10)$$

Combining these two expressions, we can write

$$\frac{s}{y} = 1 - \frac{c}{y} = \frac{g(1-\omega)}{\rho_k} \quad (11)$$

Rearranging these we find

$$\frac{\rho_k c}{\rho_k - g} = y + \frac{\omega g y}{\rho_k - g} \quad (12)$$

On a balanced growth path the rate of return and the growth rate are constant. The left-hand side is then equal to the rate of return on capital multiplied by the discounted value of future consumption[5]. Weitzman (1976) refers to this as sustainable consumption, because it is the constant flow of consumption whose discounted value equals the discounted value of actual consumption. The first term on the right hand side is income; it is clear that in a growing economy with exogenous technical progress taking place, sustainable consumption exceeds income.

The second term on the right-hand side is what Weitzman (1997) describes as a technical progress premium. It shows the extent to which technical progress makes it possible for sustainable consumption to exceed current income. But this is also the money value of the increase in the capitalised value of the non-produced factors of production. To see this we simply note that ωy is the income accruing to the non-produced factors, labour and land. On the balanced growth path the

[5] If a variable *x* grows at rate, *g*, but is discounted at ρ_k, then the discounted value equals x/(ρ_k-*g*).

capitalised value of this is $\frac{\omega y}{\rho_k - g}$. And, because the marginal products of the factors are increasing at rate *g*, the rate of increase of capital value, i.e. the capital gain, is $\frac{\omega g y}{\rho_k - g}$.